Middle Eel River

Watershed Management Plan

APPENDICES

1/19/11

APPENDIX A

Middle Eel River Watershed Initiative – 319 Grant In-Kind Partners

Manchester College
Miami County SWCD
Wabash County SWCD
Waterborne Environmental, Inc.
Friends of Miami County's Bridges
Miami County Council
Indiana Department of Natural Resources
Wabash County Highway Department
Stockdale Mill Foundation
North Manchester Center for History
North Miami High School
Indiana Smallmouth Alliance
Wabash County Surveyor
North Manchester High School
Arrow Head Country RC & D
Tippecanoe Audubon Society
Wabash County Solid Waste District
Miller's Canoe Rental
Steve and Sandy Jarvis
Manchester College Faculty

APPENDIX B

Middle Eel River Watershed Initiative – Steering Committee Members

Ed Braun – IDNR Fish and Wildlife Division
Penny Collins – Wabash County SWCD
Kevin Cordes – Landowner/Farmer
Jim Dale – Landoowner/Farmer
Morris Day – Landowner/Farmer
Rick Duff – Miami County NRCS
Rod Edgell – IDNR Fish and Wildlife Division
Troy Hattery – Miami County SWCD
Robert Hettmansperger – Wabash County SWCD
Dave Kreps – Manchester College Faculty
Terri Michaelis – Watershed Coordinator
Jon Reese – Landowner/Farmer
Sam St. Clair – Koskiusko County NRCS
Jan Stout – Miami County SWCD
Jerry Sweeten – Manchester College Faculty
Joe Updike – Wabash County NRCS
Darci Zolman – Koskiusko County SWCD

Technical Sub-Committee

Jerry Sweeten – Manchester College Faculty
Dave Kreps – Manchester College Faculty
Ed Braun – IDNR – Division of Fish and Wildlide
Rod Edgell – IDNR Division of Fish and Wildlife

Education and Outreach Sub-Committee

Penny Collins – Wabash County SWCD
Jan Stout – Miami County SWCD
Jeri Kornegay – Manchester College – Director of Media and Public Relations
Melinda Sweeten – Wabash County Solid Waste District
Jabin Burnworth – North Manchester High School

APPENDIX C

Middle Eel River Watershed Initiative - List of Media Outlets Used for Press Releases

- Wabash Plain Dealer
- Peru Tribune
- Logansport Pharos Tribune
- Manchester News-Journal
- The Paper of Wabash County
- Churubusco News
- Columbia City Post & Mail
- Warsaw Times-Union (weekly North Manchester page)
- Fort Wayne Journal Gazette
- Huntington Herald-Press
- WKUZ-FM (Wabash)
- Northeast Indianan Public Radio
- Indiana's News Center (ABC Channel 21, Fort Wayne)
- WANE-TV (CBS Channel 15, Fort Wayne)
- Indiana Public Radio
- Associated Press (Indiana bureau)
- Indiana Association of Soil & Water Conservation Districts
- Indiana Audubon Society
- Indiana State Department of Agriculture
- Indiana Wildlife Federation
- National Wild Turkey Federation
- Purdue Cooperative Extension Service (ANR)
- Natural Resources Conservation Service (Indiana)
- The Nature Conservancy
- The Nature Conservancy of Indiana
- NM Chamber of Commerce
- Wabash Area Chamber of Commerce
- Wabash Carnegie Public Library

Public Meeting Notice for local media calendars

- Columbia City Post & Mail
- Fort Wayne Journal-Gazette calendar
- Peru Tribune
- Wabash Plain Dealer
- Manchester News-Journal
- Logansport Pharos Tribune
- Fort Wayne News-Sentinel calendar

APPENDIX D

Quality Assurance Project Plan

for

Middle Eel River Initiative

ARN # 9-90

Prepared by:

Jerry Sweeten
Associate Professor of Biology
Manchester College

Prepared for:

Indiana Department of Environmental Management
Office of Water Management
NPS/TMDL Section

March 2009

Approved By:

Eel River Watershed Coordinator:	______________________ Terri Michaelis	________ Date
NPS/TMDL QA Manager:	______________________ Betty Ratcliff	________ Date
NPS/TMDL Section Chief:	______________________ Andrew Pelloso	________ Date
Watershed Branch Chief:	______________________ Marylou Renshaw	________ Date

Table of Contents

Table of Contents 6
List of Appendices......7
List of Tables 7
Distribution List......4
Section 1: Study Description 5
Historical Information 5
  Study Goals......7
  Study Site 8
  Sampling Design 8
  Study Schedule 12
Section 2: Study Organization and Responsibility 13
  Key Personnel......13
  Project Organization......14
Section 3: Data Quality Indicators......14
  Precision......14
  Accuracy 15
  Completeness......17
  Representativeness 18
  Comparability 18
Section 4: Sampling Procedures 20
Section 5: Custody Procedures 21
Calibration Procedures and Frequency......21
Section 7: Sample Analysis Procedures 21
Section 8: Quality Control Procedures......24
Section 9: Data Reduction, Analysis, Review, and Reporting......24
  Data Reduction 24
  Data Analysis......24
  Data Review......24
  Data Reporting......24
Section 10: Performance and System Audits......24
Section 11: Preventative Maintenance 24
Section 12: Data Quality Assessment......25
  Precision......25
  Accuracy 25
  Completeness......25
Section 13: Corrective Action......25
Section 14: Quality Assurance Reports......26
References......27

List of Appendices

Page

Appendix A: Watershed map……………………………………………………….…29

List of Tables

Table 1. Study Schedule for monitoring activities…………………………………………12
Table 2. Sampling procedures for three mainstem sites…………………………………19
Table 3. Sampling procedures for sites……………………………………….20
Table 4. Sampling procedures for biological data at three mainstem sites………………21
Table 5. Analytical Procedures………………………………………………………….22
Table 6. Quality Control Procedures……………………………………………………23

Distribution List

Betty Ratcliff, IDEM Quality Assurance Manager
NPS/TMDL Section
Indiana Department of Environmental Management
100 North Senate Avenue
MC 65-44 IGCN 1255
Indianapolis, IN 46204-2251
Kyle Quandt, IDEM Project Manager
NPS/TMDL Section
Indiana Department of Environmental Management
100 North Senate Avenue
MC 65-44 IGCN 1255
Indianapolis, IN 46204-2251
Jerry Sweeten
Manchester College
Biology Department
604 East College Ave.
North Manchester, IN 46962

Terri Michaelis, Watershed Coordinator
Manchester College
Biology Department
604 East College Ave.
North Manchester, IN 46962

Section 1: Study Description
Historical Information

Freshwater constitutes less than 2% of all water on earth yet freshwater ecosystems contain over 40% of fish species. In fact stream ecosystems are among the oldest geologic features on earth and contain a wide diversity of vertebrate and invertebrate species that have evolved to exist in these naturally dynamic systems. While there are no scientific investigations that provide insight into the flora and fauna or the temporal and spatial variability of stream systems prior to European settlement in North America, the change in land use has been well studied. For example, Indiana is composed of 23 million acres. Of this land area, presettlement Indiana was about a 20 million acre deciduous forest with the remaining acreage being streams, lakes, prairies, and wetlands. Today, Indiana has only about four million acres of forest. Of this, 75% is in the southern part of the state with the remainder in the north being fragmented woodlots dotted across an agricultural landscape (Jackson 1997). The majority of wetlands have been drained and the prairies are virtually nonexistant (Jackson 1997). These huge landscape level changes have resulted in terrestrial and aquatic ecosystem alterations that have not been well documented as a result of the lack of historical records. Research however does suggest that stream ecosystems are degraded proportionally more than terrestrial counterparts. For example Karr (1998) suggests that 34% of fishes, 75% of uniodid mussels, and 65% of crayfish are classified as rare to extinct compared to 11-14% for birds, mammals, and reptiles. This is perhaps a reflection of natural diffferences in ecosystem diversity or perhaps it is an indication that society is more disconnected from aquatic systems. It is easier and more convenient to watch and monitor birds than to watch and monitor fish or benthic macroinvertebrates. Over the recent past researchers and society in general have become more aware of the degraded nature of streams and lake ecosystems. Research has shed a great deal of light on the structure and function of these systems. While some of this is basic ecological research, there is also a significant body of knowledge regarding applied research that has attempted to connect anthropogenic disturbances and ecosystem health. This scientific approach has done a good job of shedding light on the degradation of ecosystems, but it has not been able to develop sufficient ways by which stream restoration and watershed best management practices can be effectively translated into improved water quality and improved biotic communities particularly for nonpoint sources of pollution. Stressors may be manifest at various levels of biological and chemical organization and when assessing streams it is important to have long-term data sets that analyze a variety of biological responses(Adams et. al 2002). In other words describing water quality problems has proved to be much easier than to assess stream ecosystem recovery. After decades of water quality legislation and the elimination of many significant pointsource pollution issues, particularly human and confined animal wastes, there appears to be some improvement (Gammon 1991).

While pointsource discharge is still a concern, the challenges now are focused on nonpoint source pollution, how to remediate them,and the best approach to quantify a change water quality or biotic communities. In this arena and of particular interest are excess nutrients, biological pathogens, mercury, and inorganic sediment (suspended and settled).
The Eel River watershed in northcentral Indiana is a major tributary to the upper wabash river. It spans six Counties and is the boundary between the Eastern Cornbelt Plains ecoregion to the

south and the Southern Michigan/Northern Indiana Drift Plains to the north. With a watershed area of just over 800 square miles, the Eelis about 110 miles long and originates in Allen County. The stream flows in a southwesterly direction and decends about two feet/mile and empties into the Wabash River near Logansport (Gammon 1990). The Eel has rich historical significance to both the Native Americans and the early European settlers who occupied the land in and around the Eel River watershed. To the Indians, the river served as a transportation route, and as a source of food and clean water. To the earler settlers, the river provdied transportation, a source of energy through the construction of mill dams, and as a source of food and water. In the more recent past, the river has served as a conduit for waste and some recreation. Before the construction of sewage treatment facilities in the 1970s and 80s effluent from humans and farm animals was typically dumped directly into the river. There are no scietific data regarding the impact of this era on the river. After the passage of the clean water act, all states were required to develop a list of impaired waterbodies each two years as outlined in the legislation under Sections 305(b) and 303(d). The results of this assessment published in 2008 lists 22 tributaries of the Eel River in Hydrologic Unit Codes (HUC) 05120104050 and 05120104060 and the HUCs for this study as impaired from *E. coli*, biotic communities, nutrients, (IDEM 2008). The Eel River fishes have been investigated, mostly as presences/absences, by Jordan (1890), Ulrey (1893), Gerking (1945), Aderkas (1962), Taylor (1972), Braun (1982 and 1988), and Gammon (1990). These surveys found 71 species of fishes in the river and tributaries (Braun 1982). Historically the Eel River has been well known as an outstanding smallmouth bass stream and people traveled from across the country to fish for Eel River bass. The river was even the destination for one of the first televised fishing shows produced by Gaddabout Gaddis the “flying fisherman”. However in Braun (1982) conducted a survey of the Eel and documented a 97% decline in smallmouth bass. The decline of smallmouth continues to be a mystery with no conclusive evidence of what was responsible for the disappearance. It is also unclear that whatever was responsible for the disappearance of this top predator may have had catestrophic effects on nongame species of fish as well as the Uniodid mussels. During this investigation, 22 stations were sampled from Logansport to Columbia City that covered about 80 river miles (Braun 1982). From 1983 to 1986 the Department of Natural Resources released over 17,000 smallmouth bass fingerlings into the river in an effort to speed the recovery of native stocks. The results from this initiative suggests that smallmouth bass survival stocked in the spring was significantly better than smallmouth bass stocked in the fall and that the native fish recolonized the river. Since this work the Department of Natural resources has sampled the river through the 1990s as well as Jim Gammon (1990).

In 1990 Gammon surveyed each of the historic 22 sampling stations and included in his research not only presences/absences, but also he evaluated habitats and assessed the overall fish community through the use of the Index of Biotic Integrity (IBI). Gammon (1990) concluded that fish fauna resembled closely that found by Taylor in 1972. The exception was mottled sculpin (*cotus gbgairdi*), blacknose dace (*Rhinichthys atratulus*), madtom (Noturus sp.), suckermouth minnow (*Phenacobius mirabilis*), largemouth bass (*Micropterus salmoindes*) and carp (*Cyprinus carpio*). Each of these species were found in greater numbers during the 1972 survey than in 1990. It appears there was some kind of catastrophic event during the 1970s that changed the fish community structure. This event was perhaps the “defining moment” in the ecological health of the Eel River however this hypothesis is based on extrapolation of the current trends in biological data. More recently, Manchester College completed a three year study on a 1.5 mile stream reach of the Eel in the town of North Manchester. The Manchester College study documented smallmouth bass nesting locations, habitat, and nest success from 2006-2008. Data from this study strongly suggests that the year class strength for smallmouth bass is closely associated with low flow conditions during the spawning season from May-June. During wet years nesting success was significantly lower than success during dry years. This study also clearly demonstrated the influence stream habitat and fish community structure and function as measured by the Qualitative Habitat Evaluation Index (QHEI) and the Index of Biotic Integrity (IBI) near a low head dam in the study reach.

Study Goals

Overall Goal: Conduct a stream water quality monitoring program that will assess the middle portion of the Eel River ecosystem based on biological, chemical, and physical parameters prior to and after the implementation of best management practices as prescribed through the watershed management plan for the middle portion of the Eel River.

Goal 1: Monitor fish community structure and function as it relates to nonpoint source pollution through the use of the index of biotic integrity (IBI) at three mainstem sites and six tributaries prior to and after the implementation of best management practices as prescribed by the watershed management plan.

Goal 2: Assess stream habitat using the qualitative habitat evaluation index (QHEI) at three mainstem sites and six tributaries.

Goal 3: Quantify the presences and/or absences of freshwater mussels at three mainstem sites and six tributaries.

Goal 4: Quantify *Escherichia coli* at three mainstem sites and six tributaries prior to and after the implementation of best management practices as prescribed by the watershed management plan.

Goal 5: Evaluate spawning habitat, year class strength, and population of smallmouth bass (*Micropterus dolomeiu*) in the mainstem of the study reach.

Goal 6: Examine water chemistry including water temperature, dissolved oxygen, conductivity, total phosphorus, nitrate nitrogen, pH, and total suspended solids. These chemical constituents will be measured throughout selected rain events prior to and after the implementation of best management practices as prescribed by the watershed management plan.

Study Site

The study site includes two 11 digit hydrologic unit codes(HUC) of 05120104060 (downstream) and 05120104050 (upstream) of the Eel River in north central Indiana (figure 1). These two sub watersheds represent approximately 30 miles of the middle portion of the Eel River and about 300 square miles of the watershed. The land use within the study site is predominantly row crop agriculture with numerous concentrated animal feed operations (CAFO). Most if not all of the tributaries of this portion of the Eel have been deemed legal drains and have been significantly modified to facilitate drainage (at least in the upper portions of the streams). The riparian forest along the mainstem and the tributaries is restricted in most areas to less than 100 feet and most of the wetlands have been drained. While there are many rural dwellings scattered across the watershed, the only towns include Laketon, Roann, Denver, and Chili. These are small communities with populations of only a few hundred people, but lack adequate waste treatment of domestic sewage.

The three primary monitoring sites on the mainstem Eel River will include stream discharge gage and automatic water sampling equipment at the most upstream site, at the watershed break between the two 11 digit HUCs and one at the most downstream portion of the 30 mile reach. The upstream site is located just downstream from the town of North Manchester at river mile 49 or 85^{o} 48’ 34.5” and 40^{o} 59’ 45.1”. The middle site is just downstream from the confluence of Pawpaw Creek at river mile 32.4 or 85o 58’ 38.7” and 40^{o} 52’ 23.9”. The most downstream site is near the town of Mexico, Indiana near old U.S. 31 or river mile 18.26 or 80^{o} 06’ 42.1” and 40^{o} 48’ 49.4”. These sites were strategically sited in order to more precisely determine the contribution nonpoint source pollution (NPS) from each sub watershed. In addition, six major tributaries were selected as sampling sites because of their major contribution to the mainstem. These six tributaries include: Beargrass Creek, Pawpaw Creek, Squirrel Creek, Otter Creek, Silver Creek, and Flower’s Creek (figure 1). While money available from this grant limits the ability of this study to gage and place an automatic water samplers at each of the six tributaries, monitoring will consist of grab sample data along with biological and physical habitat data (figure 1).

Sampling Design

The sampling approach for this project is a targeted design that will focus on the assessment and quantification of the chemical, physical, and biological attrbutes of the stream reach. The procedures for each goal are well documented in the literature and are well suited to establish conditions as they presently exist and perhaps will be adequate to detct change in water quality as a result of the installation of best management practices as prescribed by the watershed management plan. The sampling design for this project will provide results that are “data rich” compared to other sampling efforts used to detect change in water quality over time.

Goal 1: Monitor fish community structure and function as it relates to nonpoint source pollution through the use of the index of biotic integrity (IBI) at three mainstem sites and six tributaries prior to and after the implementation of best management practices as prescribed by the watershed management plan.

The structure and function of fish communities has been widely used by biologists to provide and indication of stream ecosystem health. Over the recent past, the most commonly used tool is the Index of Biotic Integrity (IBI) (Karr 1981 and Simon 1995). The IBI assesses the fish community based on 12 indices that reflect fish species richness and composition, number and abundance of sensative species, trophic organization and function, reproductive guilds, abundance, and individual fish condition. Scores range from 0 (no fish present) to 60. A score of 60 represents an excellent fish community as compared to the best reference site for a particular ecoregion. Research from across the United States has clearly demonstrated the effectiveness and reliability of using the IBI as a stream monitoring tool. ThIBI will be calculated for each of the three mainstem sites and each of the six tributaries once each year over the course of the grant periord (4-years) beginning in the summer of 2009. Fish will be identified to species and scoring will be based on IBI calibration for the eastern cornbelt ecoregion (Simon 1995).

Goal 2: Assess stream habitat using the qualitative habitat evaluation index (QHEI) at three mainstem sites and six tributaries.
Stream habitat will be quantified for each of the three mainstem monitoring sites and for each of the six tributaries. Habitat scores will be based on the Qualitative Habitat Evaluation Index (QHEI) (Rankin 1989). The QHEI provides an assessment tool used widely by stream biologists to quantify the physical parameters that provide habitat for fish and benthic macroinvertebrates. Research has clearly shown positive correlations between QHEI scores and biological-base indices like the IBI (Rankin 1989). It is very important to connect land use and habitat availability or degradation. There are six variables used to calculate the QHEI and scores range from 0-100. QHEI scores greater than 60 suggest the stream reach is a suitable for warmwater habitat without use impairment. Scores of 45 to 60 may meet warmwater habitat in some circumstances, but it may show some level degradation suggests a classification as a modified warmwater habitat. A QHEI score between 32 and 45 meets modified warmwater habitat. A score of less than 32 may be suitable for modified warmwater habitat only if the watershed is greater than three square miles. Where modified warmwater habitat is not possible, the stream reach is classified as a limited resource stream (Rankin 1989 ,Cain 2008 and IDEM/ SOP 2002).

Goal 3: The presences and/or absences of freshwater mussels will be documented at three mainstem sites and six tributaries.
Freshwater mussels are some of the most imperiled organisms in North America. The Eel River fauna is represented by 29 species (Fisher personal communication). Of these 29 species, 24 species have been documented alive and 5 species have only been documented as weather dead shells. Within the middle Eel River, there are two federally endangered species that have been documented only as weather dead shells and one state endangered species that has been found alive only in the lower reaches of the river with only weathered dead speciemen in the upper portion of the river. Once during the 4-year study a survey of mussel species will be documented at each of the three mainstem monitoring sites and at each of the monitoring sites. A standard one hour roving survey will be used to document location of mussel species and mussel beds. These areas will be documented on GIS. Species verification will be provided by Brant Fisher, Aquatic nongame biologist for the Indiana Department of Natural Resources.

Goal 4: *Escherichia coli* will be quantified prior to and after the implementation of best management practices as prescribed by the watershed management plan.
Escherichia coli quantification is routinely used in stream water quality monitoring as an indicator of "safe conditions". In Indiana all waters are designated for full body contact recreational use between April and October. In Indiana the water quality standard for E.coli is 125 colony forming units (CFU)/ 100 mL as a geometric mean based on not less than 5 samples equally spaced over 30-d or 235 CFU/100mL in any one sample in a 30-d period. *E. coli* will be strtegically sampled and measured once each two weeks at each of the sites as grab samples and for selected rain events from the three primary monitoring sites.

Goal 5: Evaluate spawning habitat, year class strength, and population of smallmouth bass (*Micropterus dolomeiu*) in the mainstem of the study reach.
Smallmouth bass is the top predator found in the Eel River and a very popular species of fish for fishermen. To assess the status of smallmouth bass in the middle Eel River a two kilometer section of the river upstream from the location of each of the three monitoring sites will be evaluated. Water temperature, stream velocity, water depth, nest diameter, distance from shore, distance from cover, and latitude/longitude will be documented for each nest. Number of eggs present in 10% of the nests located will be quantified. The zippin depletion method of population estimation will be used to estimate the smallmouth bass population in three one kilometer sections of the river upstream from the mainstem monitoring sites once in 2009 and once in 2011.

Goal 6: Examine water chemistry including water temperature, dissolved oxygen, conductivity, total phosphorus, nitrate nitrogen, pH, and total suspended solids. These chemical constituents will be measured throughout selected rain events prior to and after the implementation of best management practices as prescribed by the watershed management plan.
While it is well known that water chemistry is important in any water quality monitoring initiative, most often selected parameters are measured as grab samples and are taken daily, weekly, or at somewhat random intervals without knowledge of stream discharge. These data give only a small glimse into the dynamic nature of streams and may not provide a clear representation of organismal exposure or loadings of any of the constiuents being analyzed. This monitoring initiative will include three sample sites on the mainstem of the river that will be equiped with Isco automatic water samplers that will allow water samples to be taken from the river throughout storm events and multiple times daily during baseflow conditions. The sampler will be connected to a pressure transducer and a datalogger that will record continually stream discharge and water temperature. The data loggers will also be programmed to communicate with the water sampler. The sampling regime will involve six 1-Liter samples to be taken daily at baseflow condition. These samples will be analyzed daily as a composite sample by thoroughly mixing all six liters of water. From this a one liter aloquot will be taken for analysis. During storm events when the stage height increases 0.5 feet or about 100 cubic feet per second (cfs), the sampler will collect one sample of water each 6-hours. This sampling frequency will continue until the stage height returns to the median discharge. Whether the stream is at baseflow or there is a storm event, the samples will be collected daily. The samples will be taken to the laboratory at Manchester College and either preserved for analysis at a later time or analyzed immediately. This sampling design will allow quatification of exposure rates and data that can be used to calculate stream loadings. Sampling will take place from 1 May-31 June. These dates coincide well with planting times of agricutural crops and with the spawning activity of most fish.
Parameters that will be measured on-site daily include: water and air temperature (^{o}C), pH, Conductivity (microsiemens/cm), Dissolved Oxygen (mg/L), and stream dishcharge (cubic feet per second). Total Phoshporus (mg/L), Nitrate (mg/L), Total Suspended Solids (mg/L and NTU) will be taken back to the laboratory for analysis.

Study Schedule

Table 1. Study Schedule for monitoring activities.

Activity	Start Date	End Date
Goal 1: Fish Community Assessment	July/August 2009	July 2012
Goal 2: QHEI	July/August 2009,	July 2012
Goal 3: Freshwater mussel survey	July/August 2010	July/August 2010
Goal 4: *Escherichia coli* monitoring	May 2009	July 2012
Goal 5: smallmouth bass assessment	May-June 2009	June 2012
Goal 6: Water chemistry	May-June 2009	June 2012

Section 2: Study Organization and Responsibility

Key Personnel

Terri Michaelis
Manchester College
604 East College Ave.
North Manchester, IN 46962
Phone: 260-982-5307
Email: tmmichaelis@manchester.edu
Role: Watershed Coordinator

Jerry Sweeten
Manchester College
604 East College Ave.
North Manchester, IN 46962
Phone: 260-982-5307
Email: jesweeten@manchester.edu
Role: In charge of water quality monitoring initiative

Dave Kreps
Manchester College
604 East College Ave.
North Manchester, IN 46962
Phone: 260-982-5307
Email: dpkreps@manchester.edu
Role: In charge of E.coli testing

Rod Edgell
Indiana Department of Natural Resources
1305 Governors Drive
Columbia City, Indiana 467285
Phone: 260-244-6805
Email: REdgell@dnr.in.gov

Project Organization

- Terri Michaelis is the watershed coordinator and is responsible to the Steering Committee.
- Jerry Sweeten is responsible for the water quality monitoring and reports to the watershed coordinator and the steering committee.
- Five Manchester College students will be hired as laboratory and field technicians. These students will report to Jerry Sweeten.

Section 3: Data Quality Indicators

Precision

All stream quaity parameters outlined in the six goals are divided by chemical, physical and biological paramters. During base-flow conditions, chemical parameters will be based on daily composite samples for three mainstem sites where six 1-liter samples will be collected daily and combined for a 1-L alliquot to be analyzed. These samples will be collected by 6712 Isco automatic water samplers. During storm events, a one liter discrete sample will be collected by the ISCO sampler each 6-h at each of the three mainstem sites. The water samples will be returned to the laboratory at Manchester College for analysis. The storm event samples will be collected daily until the stream gage height returns to the median level as determined by the USGS gage station in the town of North Manchester. For each water chemistry parameter (field and laboratory) duplicate samples or replicated readings will be taken after each ten samples or readings. The relative percent difference (RPD) will be used to calculate the precision of each not to exceed 20%. If a 20% difference is observed analysis test mentods will be reviewed and modified to bring the RPD within the stated 20%. This may require equipment to be recalibrated to the specifications provided by the manufacturer.

With two replicate samples taken, precision will be determined by calculating the Relative Percent Difference (RPD):

$$RPD = \frac{(C - C') \times 100\%}{(C + C')/2}$$

Where:
C = the larger of the two values
C' = the smaller of the two values

E.coli Testing

The filter membrane determination (SM 9222-B for *E. coli* colony forming units (CFU) will be used as described in the *Standard Methods for the Examination of Water and Wastewater*, 20th Ed and approved by Standard Methods Committee, 1997. Each batch of mTEC agar will be evaluated for consistency by inoculating test plates with known concentrations of *E. coli, and* each sampling period will include a field control involving sterile water added to one of the sample bottles.

1. Field and laboratory controls will be incorporated into the protocols.
2. All samples must be recorded in the field notebook.
3. All laboratory technicians will be required to follow "Standard Operating Procedures" listed in laboratory procedure manuals. Methods covered will include proper use of an autoclave, sample bottle preparation, field sampling, laboratory media and buffer preparation, membrane filtration techniques, data gathering, data interpretation, recording of data, and proper safety and hygiene practices in a microbiology laboratory.
4. Data will be recorded in both lab notebooks and computer spreadsheet.
5. Shaker water baths will be monitored for temperature stability.

Accuracy

All equipment will be calibrated according to manufacturer's instructions at the beginning of each field season and as necessary as determined by precision calculations. This will include the use of recommended methods, reagents, and frequencies. When possible sample blanks (deionized water) will be analyzed 5% of the time. If any data is questionable by falling outside the expected range of results, the data will be noted as questionable. The instrument(s) will subsequently be recalibrated. Please see specific procedures below.

Field Equipment:

Dissolved Oxygen meter/probe:

Hach luminescence probe and HQ40meter. Hach Method 10360 will be used to calibrate once at the beginning of each field season. New batteries will also be installed at the beginning of each field season and replaced as necessary. Duplicate readings will be made in the field every 10 readings to insure accuracy and precision.

Conductivity meter:

Hach Sension 5: Calibration will be completed in the laboratory using a known standard according to the manufactures instructions and batteries will be replaced as indicated by the meter.

Stream Discharge: Pressure Systems Series 500 pressure transducer and Campbell Scientific Data Logger will be used to calculate discharge in cubic feet per second (CFS). This equipment will be calibrated according to the specifications outlined by the manufacturer and a stream discharge rating curve will be calculated by the USGS using a hydroacoustic Doppler current profiler at each of the three sites. The ISCO water samplers will be installed with the assistance of engineers from Waterborne, Inc.

Laboratory Equipment
Hach DR 5000 UV-VIS spectrophotometer:
This spectrophotometer will be used to determined concentrations of nitrate and total phosphorus. Hach TNT plus method will be used for total phosphorus to reduce the chances for errors. The cadmium reduction method will be used for nitrate. The DR 5000 uses an internal calibration system. Spectrophotometer light source will be changed as needed.
Hach 2100 Turbidimeter:
A turbidity standards calibration kit ranging from 0.1 NTU-1,000 NTU will be used to calibrate at the beginning of each field season and the light source will be changed as needed.
Total Suspended Solids:
This parameter will be measured gravimetrically (mg/L) and recorded as NTU (above). Sterile 47 mm filters (0.45 micron) will be used. Deionized water will be used to calibrate TSS at 0. A Fisher M-220 analytical balance will be used to weigh the filters.
Standards: Standards will be used to assess the accuracy of laboratory equipment at the beginning of each field season for NTU, Nitrate, and Phosphorus. Standards accuracy will be determined by :

$$\%B = \frac{(x - T) \times 100}{T}$$

Where:
x = the mean of the results of duplicate analyses of the check standard
T = the concentration of the check standard

Biological Monitoring

Index of Biotic Integrity (IBI):
An appropriate stream reach will be sampled according to IDEM and EPA protocols for this index calculation. Electrofishing and seining will be used during periods when the water is low and clear enough to see fish clearly and to insure a valid representation of all fish species present will be sampled. Taxonomic keys will be used by trained personnel to identify species that are not readily identified in the field and all fish will be identified to species. Voucher specimen will be used as well.

Mussel Survey:
A roving survey during low flow conditions will be used to prepare a mussel species list for each of the sample sites. Taxonomic keys will be used by trained personnel to identify the mussels and Brant Fisher, Aquatic Nongame Biologist with IDNR will be used to verify identification.

Qualitative Habitat Evaluation Index (QHEI): This parameter will be conducted simultaneously by two trained personnel. Scores will be compared and averaged when or if there is disagreement. The QHEI will be conducted using procedures outlined by IDEM Office of Surface Water Quality.

E.coli testing

The filter membrane determination of *E. coli* colony forming units (CFU) will conform to protocols as described in USEPA 1603.

1. Field and laboratory controls will be incorporated into the protocols.
2. All samples must be recorded in the field notebook.
3. Each batch of mTEC agar will be evaluated for consistency by inoculating test plates with known concentrations of *E. coli.*
4. All laboratory technicians will be required to follow "Standard Operating Procedures" listed in laboratory procedure manuals. Methods covered will include proper use of an autoclave, sample bottle preparation, field sampling, laboratory media and buffer preparation, membrane filtration techniques, data gathering, data interpretation, recording of data, and proper safety and hygiene practices in a microbiology laboratory.
5. Data will be recorded in both lab notebooks and computer spreadsheet.
6. Shaker water baths will be monitored for temperature stability.

*All field and laboratory data will be entered into a laboratory notebook and then into an excel spreadsheet.

Completeness
Water chemistry and *E. coli* analysis is expected to be at least 95% completed each field season and all field data including biological data should be 100% unless the stream discharge is unusually high throughout the sampling period and would result in a safety risk to personnel.

Representativeness
Three gaged sites fitted with automatic water samplers, pressure tranducers, and data loggers will be positioned at the lower, middle and upper portions of the study reach (30 miles) (see Study Site Section). These sites are specifically located at the watershed breaks for each of the two 11digit HUCs. Stream discharge will be monitored continuously throughout the field season (May-August) and water samples will be collected daily during the months of May-June. Grab samples will be collected weekly at six tributaries. *E. coli* analysis will include biweekly samples of the sites and the three permanent monitoring sites through at least May and June as well as more frequent sampling during selected rain events. As a result of this sampling design, NPS contributions from each HUC can be calculated.

Comparability
All water chemical data will be collected using EPA approved methods through the use of equipment purchased from Hach Company, Campbell Scientific (data loggers) and Teledyne ISCO water samplers. All biological data will be collected using procedures used by IDEM and/or IDNR or EPA.

Section 4: Sampling Procedures

Table 2: Sampling procedures for three mainstem sites

Parameter	Sample Matrix	Sampling Frequency	Sampling Method	Sample Container	Sample Volume	Holding Time
Total Phosphorus	**Lab**	**Daily**	**ISCO 6712 Composite and time integrated**	**polypropylene**	**1-L**	**8-h unless preserved with acid**
Nitrate-Nitrite	**Lab**	**Daily**	**ISCO 6712 Composite and time integrated**	**polypropylene**	**1-L**	**48-h cool at 4 C**
pH	**Lab**	**Daily**	**NA**	**NA**	**1-L**	**4-h**
Conductivity	**Field**	**Daily**	**NA**	**NA**	**NA**	
Temperature	**Field**	**Daily**	**NA**	**NA**	**NA**	
Total Suspended Solids	**Lab**	**Daily**	**Composite and time integrated Gravimetric and NTU**	**polypropylene**	**1-L**	**7-d**
Stream Discharge	**Field**	**30-minutes**	**CFS**	**NA**	**NA**	**NA**
Dissolved Oxygen	**Field**	**Daily**	**NA**	**NA**	**NA**	**NA**
E. coli	**Lab**	**Bi-weekly**	**Composite**	**Sterile bottles**	**1-L**	**6-h**

Table 3: Sampling procedures for sites

Parameter	Sample Matrix	Sampling Frequency	Sampling Method	Sample Container	Sample Volume	Holding Time
E.coli	**Lab**	**Bi-weekly**	**Grab sample**	**sterile**	**1-L**	**6- h**
Total Phosphorus	**Lab**	**weekly**	**Grab Sample Persulfate digestion**	**polypropylene**	**1-L**	**8-h unless preserved with acid**
Nitrate-Nitrite	**Lab**	**weekly**	**Grab Sample Cadmium reduction**	**polypropylene**	**1-L**	**48-h cool at 4 C**
pH	**Lab**	**Weekly**	**NA**	**NA**	**1-L**	**4-h**
Conductivity	**Field**	**Weekly**	**NA**	**NA**	**NA**	**immediate**
Temperature	**Field**	**Weekly**	**NA**	**NA**	**NA**	**immediate**
Total Suspended Solids	**Lab**	**Weekly**	**Grab Sample Gravimetric and NTU**	**polypropylene**	**1-L**	**7-d**
Dissolved Oxygen	**Field**	**Weekly**	**NA**	**NA**	**NA**	**NA**

Table 4: Sampling procedures for biological data at three mainstem sites

Parameter	Sample Matrix	Sampling Frequency	Sampling Method	Sample Container	Sample Volume	Holding Time
IBI	**Field**	**Annually**	**EPA/IDEM**	**NA**	**NA**	**NA**
QHEI	**Field**	**Annually**	**EPA/IDEM**	**NA**	**NA**	**NA**
Mussel Survey	**Field**	**Once in 4-y**	**Roving survey IDNR**	**NA**	**NA**	**NA**

Section 5: Custody Procedures

Water samples will be collected daily from the ISCO water samplers at each of the three mainstem monitoring sites and weekly samples will be collected at each of the six tributaries. Trained personnel will place the water samplers in a crate for transportation to the laboratory at Manchester College. The samples will be analyzed either immediately or preserved with sulfuric acid and refrigerated for later analysis.

Calibration Procedures and Frequency

Please see the Accuracy Section.

Section 7: Sample Analysis Procedures

All water quality laboratory analysis will be completed using EPA approved procedures using Hach analytical equipment (table 6). Water samples will be collected daily from each of the three mainstem sites. The ISCO 6712 water samplers will be programmed to take six 1-L water samples daily at base flow conditions. These samples will be combined and for a daily composite analysis. If the stream rises 0.5 feet the samplers will collect one water sample every 4-h. These samples will be collected daily and analyzed separately to provide data that may be used to calculate mass loadings. One liter grab samples will be collected daily from each of the six tributaries. Dissolved oxygen (mg/L), temperature (^{o}C), and conductivity (µmhos/cm) will be measured daily at the three mainstem sites and weekly at the sites. Refer to Table 6 for details.

Table 5: Analytical Procedures

Parameter	Analytical Method	Performance Range or Detection Limits	Units
E.coli	USEPA 1603	1CFU/100 mL	CFU
Total Phosphorus	EPA 365.2	0.6-4.5 mg/L	mg/L
Nitrate nitrogen	SM 4500-NO3 (F)	0-30 mg/L	mg/L
pH	EPA 150.1	2-14	pH
Conductivity	EPA 120.1	0.01-19.99	(µmhos/cm)
Temperature	Hach HQ40	0.1 C^{o}	
Total Suspended Solids	SM 2540 D	0-4000 NTU	NTU and mg/L
Dissolved Oxygen	EPA 360.2	0.1-20 mg/L	mg/L
Weight/mass	Fisher M-220	0.01-220 g	g/mg

Section 8: Quality Control Procedures

All personnel will be adequately trained in:

- the use and calibration of all field and laboratory equipment.
- the application of IBI and QHEI.
- the DQIs and how to detect questionable data and what procedures to follow should it exist
- analytical procedures for each analysis
- keeping a well organized and accurate laboratory notebook
- properly entering data into Excel

Table 6: Quality Control Procedures

Quality Control Procedure	**Field (Yes/No)**	**Laboratory (Yes/No)**	**Frequency**
Duplicate water analysis	Yes	Yes	Every 10 readings or sample
Equipment calibration	No	Yes	At the beginning of each field season or if RPD>20%
Duplicate personnel to do QHEI	Yes	No	annually
Verify specimen identification	Yes	Yes	As needed
Blank	Yes	Yes	5%

Section 9: Data Reduction, Analysis, Review, and Reporting

Data Reduction

All data will be recorded into laboratory notebooks and later entered into an Excel spreadsheet. Data will be reviewed by Jerry Sweeten to check for any errors. Descriptive statistics and inferential statistics will be used to expose any patterns or trends that may appear in the data and all data will be compared to either previous studies in the case of biological data from IDEM and IDNR and chemical data will be compared against water quality standards. Tables and graphs will be created to facilitate the observations of patterns in the data. Data will be compared at each of the three subwatershed mainstem sites to determine what contribution of NPS is from above the study reach and from each of the two 11-digit HUCs. Data will be recorded in the appropriate units and mass loading calculations may be made. These calculations will be for nitrate, total Phosphorus, and suspended sediment. Since this is a 4-year project, data acquired prior to the implementation of best management plans as prescribed by the watershed management plan will be compared to data collected after implementation of the best management plans as prescribed by the watershed management plan. This will be in an attempt to detect any change in water quality that may result from best management practices. Results will be written in a final report (electronic and paper) and presented as oral presentations.

Data Reporting

All raw data and data analysis results generated as part of this grant project will be submitted in an electronic format with the Final Report to the IDEM Project Manager or Quality Assurance Manager. The format will be compatible with the software currently used by IDEM. PowerPoint presentations will be created using audience specific formats.

Section 10: Performance and System Audits

Faculty and student technicians will meet each week during the field season and review analytical procedures and data the collected. IDEM reserves the right to conduct external performance and/or systems audits of any component of this study.

Section 11: Preventative Maintenance

All field and laboratory equipment will be maintained through replacing batteries, lamps, pumps, or any other part necessary to the precision and accuracy of data collection. If a piece of equipment is breaks it will be replaced by the same or newer model from the same manufacturer. Preventive maintenance will occur prior to each field season or as necessary during the field season. Other than batteries, spare parts or equipment replacement can be expedited through overnight shipments.

Section 12: Data Quality Assessment

Precision

Described in Section 3. Outliers will be determined by statistical analysis and not be used in the overall data analysis. If the outliers are determined to be a result of equipment failure or personnel error, then corrective action (perhaps equipment repair or additional personnel training) will be taken immediately to alleviate the issue in the future.

Accuracy

Water Chemistry:
Should water chemistry data (field or laboratory) be determined to fall outside the "normal" expected value as a result of equipment or personnel error, it will not be used in the final analysis. Immediate action will be taken to repair or replace equipment and personnel will be retrained on procedures if necessary.

Biological Data:
Species identification will be verified by Jerry Sweeten or other experts if necessary to insure that all indices are calculated on valid data. No indices will be calculated based on student technician identification without verification from at least one professional level biologist. Relevant taxonomic keys and voucher specimen will be used. While procedures will prevent inaccurate data in this area, should accuracy goals be compromised the data will not be used in the analysis.

Completeness

The sampling strategies outlined in this study are "data rich". Having the capability to examine water samples throughout storm events, composite samples during base flow conditions, and grab samples will allow a more clear picture of how much NPS is moving down the stream as well as quantification of biotic exposure. These values will allow comparison of loadings and exposures before and after the implementation of best management practices and across years during the four years of the grant. The only reason biological data could not be collected is if it was an extremely wet year and the river remained muddy and discharge compromised the safety of personnel.

Section 13: Corrective Action

Whenever it is deemed that corrective action is needed, it will be completed as soon as possible. Corrective action may be spawned by data that are suspect. To avoid these situations preventive maintenance, adequate technician training, and equipment/reagent replacement will be monitored continuously.

Section 14: Quality Assurance Reports

Quality Assurance (QA) reports will be submitted to IDEM's Watershed Management Section every three months during the field season as part of the Quarterly Progress Report and/or Final Report.
Actions and procedures used to assess chemical, physical, and biological data in terms of its accuracy, precision and completeness
A record of equipment maintenance, calibrations, duplicate and replicate sampling.
A record of any data that was outside the RPD or appeared to be erroneous as a result of mechanical or personnel errors as well as the solutions to these problems. This discussion will also include any ways these errors might affect decision making in regards to patterns or trends in the data interpretation.

QAPP References

Aderkas, E. 1962. Fisheries survey of selected Indiana streams. Fisheries Research Report, Indiana Department of Conservation, Vol. 5, No. 2, pp 53.

Angermeier, P.L. and J.R. Karr. 1986. Applying an Index of Biotic Integrity based on stream fish communities: considerations in sampling and interpretation. North American Journal of Fisheries Management. 6: 418-429.

Angermeier, P.L. and I.J. Schlosser. 1987. Assessing biotic integrity of the fish community in a small, Illinois stream, North American Journal of the American Fisheries Society. 7, 331-338.

Braun, E.R. and R. Robertson. 1982. Eel River watershed fisheries investigation 1982. Indiana Department of Natural Resource, Division of Fish and Wildlife, Indianapolis, IN.

Cain, M.L. and T.L. Lauer, J.K. Lau. 2008. Habitat use of grass pickerel Esox americanus vermiculatus in Indiana streams. American Midland Naturalist, 160: 96-109.

Dufour, R. Guide to appropriate metric selection for calculating the index of biotic integrity (IBI) for Indiana rivers and streams. Dufour Consulting, Indianapolis, IN

Gammon, J.R. 1991. The environment and fish communities of the middle Wabash River. A report for Eli Lilly and PSI Energy. DePauw University, Greencastle, Indiana.

Gerking, S.D. 1945. The distribution of the fishes of Indiana. Investigation Indiana Lakes and Streams, Vol. III: 1-137.

Hoggatt, R.E. 1975 Drainage areas of Indiana streams. U.S. Geologic Survey, Water Resources Division, Indianapolis, IN.

Jackson, M. 1997. The natural heritage of Indiana.Indiana University Press, Bloomington, Indiana

Jordan, D.S. 1890. Reporet of explorations made during th esummer and autumn of 1888, in the Allegheny region of Virginia, North Carolina, and Tennessee, and in western Indiana, with an account of the fishes found in each of the river basins of those regions. Bull.U.S. Fish Commission 1888, 8: 97-173.

Karr, J. R. 1981. Assessment of biotick integrity using fish communities, Fisheries, 6(6), 21-27.

Karr, J.R., P.R. Yant, K.D. Fausch, and I.J. Schlosser. 1987. Spatial and temporal variability of the index of biotic integrity in three midwestern streams, Transactions of the American Fisheries Society, 116, 1-11.

Omernik, J.M. 1995. Ecoregions: a spatial framework for environmental managemenet, in W. S. Davis and T.P. Simon (Eds.), *Biological Assessment and Criteria: Tools for Water Resources Planning and Decision Making*. Lewis, Boca Raton, FL. 49-62.

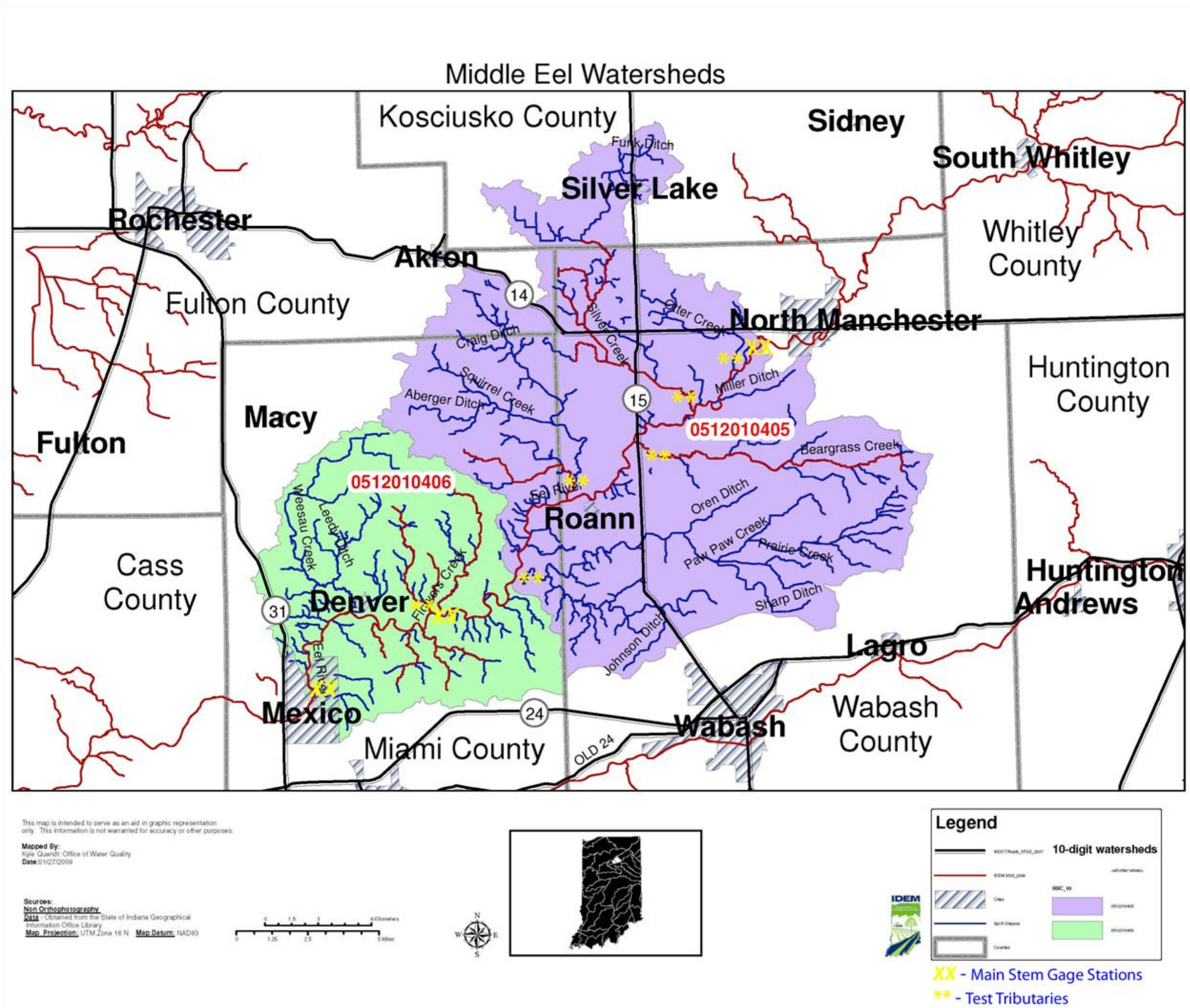
Rankin, E.T. 1989. The qualitative evaluation index (QHEI): rationale, methods, and application. Ecological Assessment Section, Ohio Environmental Protetection Agency, Columbus, Ohio.

Simon, T.P. and J. Lyons. 1995. Applications of the index of biotic integrity to evealuate water resource integrity in freshwater ecosystems, in W. S. Davis and T.P. Simon (Eds.), *Biological Assessment and Criteria: Tools for Water Resources Planning and Decision Making*. Lewis, Boca Raton, FL. 245-262.

Standard Methods for the Exazmination of Water and Wastewater. 1998. American Public Health Associatoin, American Water Works Association, and the Water Environment Federation. American Public Helath Association, Washington, DC.

Taylor, M. 1972. Eel River watershed fisheries investigations report 1972. Indiana Department of Natural Resources, Division of Fish and Wildlife, Indianapolis, IN.

QAPP - Appendix A: Two 11-digit HUCs for the middle eel river initiative. Yellow XX indicates locations for the three permanent monitoring locations and the yellow * indicates the six tributaries that will monitored



Appendix D-27

APPENDIX E – Middle Eel River Watershed Initiative - Fish Survey 2009

2009 Number of individuals per species collected by use of a backpack Electrofisher at the Blocher Farm site (40^{o} 59’ 30.86”N and 85^{o} 48’ 30.35”W) for obtaining the IBI score

Scientific Name	Common name	Number of individual per species collected
Notropis rubellus	rosyface shiner	14
Semotilus atromaculatus	creek chub	41
Cottus bairdi	sculpin	26
Ericymba buccata	silverjaw minnow	9
Hybopsis amblops	bigeye chub	3
Etheostoma nigrum	johnny darter	7
Pimephales notatus	bluntnose minnow	4
Notropis stramineus	sand shiner	1
Ambloplites rupestris	rockbass	1
Campostoma anomalum	stoneroller	12
Etheostoma blenniodes	greenside darter	2
Lepomis macrochirus	bluegill	1
Percina maculata	blackside darter	3
	DELT	1

2009 Number of individuals per species collected by use of a boat shocker at the Blocher Farms (40° 59' 30.86"N and 85° 48' 30.35"W) for obtaining the IBI score

Scientific Name	Common name	Number of individuals per species collected
Micropterus dolomieui	smallmouth bass	7
Hypentelium nigricans	northern hogsucker	4
Catostomus commersoni	white sucker	30
Moxostoma erythrurum	golden redhorse	35
Cyprinus carpio	carp	1
Notropis spilopterus	spotfin shiner	6
Notropis photogenus	silver shiner	12
Ambloplites rupestris	rockbass	5
Nocomis micropogon	river chub	3
Luxilus chrysocephalus	striped shiner	19
Lepomis macrochirus	bluegill	4
Lepomis cyanellus	green sunfish	1
Notropis rubellus	rosyface shiner	3
	DELT	2

2009 Total number of individuals per species collected by use of both a boat shocker and a backpack Electroshocker at the Blocher Farms (40° 59' 30.86"N and 85° 48' 30.35"W) for obtaining the IBI score

Scientific Name	Common name	Number of individual per species collected
Notropis rubellus	rosyface shiner	19
Semotilus atromaculatus	creek chub	45
Cottus bairdi	sculpin	26
Ericymba buccata	silverjaw minnow	9
Hybopsis amblops	bigeye chub	3
Etheostoma nigrum	32ohnny darter	7
Pimephales notatus	bluntnose minnow	4
Notropis stramineus	sand shiner	2
Ambloplites rupestris	rockbass	6
Campostoma anomalum	stoneroller	12
Etheostoma blenniodes	greenside darter	2
Lepomis macrochirus	bluegill	4
Percina maculata	blackside darter	3
Micropterus dolomieui	smallmouth bass	7
Hypentelium nigricans	northern hogsucker	4
Moxostoma erythrurum	golden redhorse	35
Cyprinus carpio	carp	1
Notropis spilopterus	spotfin shiner	6
Luxilus chrysocephalus	striped shiner	19
Nocomis micropogon	river chub	3
Catostomus commersoni	white sucker	30
Lepomis cyanellus	green sunfish	1
Notropis photogenus	silver shiner	12
	TOTAL SPECIES = 22	TOTAL INDIVIDUALS = 260
	*DELT	3

Appendix E-3

2009 Number of individuals per species collected for use in obtaining the IBI score by use of a backpack Electrofisher slightly downstream from the convergence of Paw Paw Creek and the Eel River (40° 52’ 21.45” and 85° 58’ 49.48” W)

Scientific Name	Common name	Number of individuals per species collected
Lepomis cyanellus	green sunfish	2
Notropis rubellus	rosyface shiner	16
Notropis stramineus	sand shiner	2
Semotilus atromaculatus	creek chub	33
Notropis spilopterus	spotfin shiner	1
Ambloplites rupestris	rockbass	3
Etheostoma nigrum	33ohnny darter	4
Pimephales notatus	bluntnose minnow	5
Etheostoma blenniodes	greenside darter	1
Ericymba buccata	silverjaw minnow	1
Hybopsis amblops	bigeye chub	2
	DELT	3

2009 Number of individuals per species collected for use in obtaining the IBI score by use of a boat shocker slightly downstream from the convergence of Paw Paw Creek and the Eel River (40^{o} 52' 21.45" and 85^{o} 58' 49.48" W)

Scientific Name	Common name	Number of individuals per species collected
Moxostoma erythrurum	golden redhorse	86
Cyprinus carpio	carp	10
Carpiodes carpio	rivercarp sucker	11
Luxilus chrysocephalus	striped shiner	23
Catostomus commersoni	white sucker	11
Lepomis megalotis	longear sunfish	5
Notropis photogenus	silver shiner	16
Notropis spilopterus	spotfin shiner	5
Hypentelium nigricans	northern hogsucker	19
Nocomis micropogon	river chub	5
Ambloplites rupestris	rockbass	6
Dorosoma cepedianum	gizzard shad	1
Minytrema melanops	spotted sucker	1
Hybopsis amblops	bigeye chub	11
Notropis rubellus	rosyface shiner	23
Lepomis cyanellus	green sunfish	2
Etheostoma nigrum	34ohnny darter	1
Lepomis macrochirus	bluegill	2
Pimephales notatus	bluntnose minnow	4
Micropterus dolomieui	smallmouth bass	6
Lepomis microlophus	redear sunfish	1
Micropterus salmoides	largemouth bass	1
	DELT	4

2009 Total number of individuals per species collected for use in obtaining the IBI score by use of a boat shocker and a backpack Electroshocker slightly downstream from the convergence of Paw Paw Creek and the Eel River(40^{o} 52’ 21.45” and 85^{o} 58’ 49.48” W)

Scientific Name	Common name	Number of individual per species collected
Moxostoma erythrurum	golden redhorse	86
Cyprinus carpio	carp	10
Carpiodes carpio	rivercarp sucker	11
Luxilus chrysocephalus	striped shiner	23
Catostomus commersoni	white sucker	11
Lepomis megalotis	longear sunfish	5
Notropis photogenus	silver shiner	16
Notropis spilopterus	spotfin shiner	6
Hypentelium nigricans	northern hogsucker	19
Nocomis micropogon	river chub	5
Ambloplites rupestris	rockbass	9
Dorosoma cepedianum	gizzard shad	1
Minytrema melanops	spotted sucker	1
Hybopsis amblops	bigeye chub	13
Notropis rubellus	rosyface shiner	39
Lepomis cyanellus	green sunfish	4
Etheostoma nigrum	johnny darter	5
Lepomis macrochirus	bluegill	2
Pimephales notatus	bluntnose minnow	9
Micropterus dolomieui	smallmouth bass	6
Lepomis microlophus	redear sunfish	1
Micropterus salmoides	largemouth bass	1
Ericymba buccata	silverjaw minnow	1
Etheostoma blenniodes	greenside darter	1
Semotilus atromaculatus	creek chub	33
	TOTAL SPECIES = 25	TOTAL INDIVIDUALS = 318
	*DELT	7

Appendix E-6

2009 Number of individuals per species collected for use in obtaining the IBI score by use of backpack Electorshocker in Mexico, IN on the Eel River(40° 48’ 59.95”N and 86° 06’ 32.55”W)

Scientific Name	Common name	Number of individuals per species collected
Lepomis macrochirus	bluegill	10
Lepomis cyanellus	green sunfish	34
Etheostoma blenniodes	greenside darter	6
Etheostoma spectabile	orangethroat darter	5
Notropis rubellus	rosyface shiner	4
Notropis photogenus	silver shiner	2
Pimephales notatus	bluntnose minnow	75
Cottus Bairdi	sculpin	17
Semotilus atromaculatus	creek chub	20
Campostoma anomalum	stoneroller	32
Ambloplites rupestris	rockbass	5
Lepomis microlophus	redear sunfish	2
Micropterus salmoides	largemouth bass	2
Notropis stramineus	sand shiner	3
Etheostoma nigrum	36ohnny darter	6
Lepomis gibbosus	pumpkin seed	4
Hybopsis amblops	bigeye chub	2
Fundulus cingulatus	top minnow	4
Erimyzon oblongus	creek chubsucker	1
Percina maculata	blackside darter	1
Catostomus commersoni	white sucker	4
	DELT	0

2009 Number of individuals per species collected for use in obtaining the IBI score by use of a boat shocker in Mexico, IN on the Eel River(40^{o} 48' 59.95"N and 86^{o} 06' 32.55"W)

Scientific Name	Common name	Number of individuals per species collected
Moxostoma erythrurum	golden redhorse	38
Catostomus commersoni	white sucker	5
Notropis rubellus	rosyface shiner	66
Notropis photogenus	silver shiner	37
Hypentelium nigricans	northern hogsucker	40
Luxilus chrysocephalus	striped shiner	42
Notropis spilopterus	spotfin shiner	30
Lepomis macrochirus	bluegill	3
Lepomis megalotis	longear sunfish	8
Lepomis cyanellus	green sunfish	6
Hybopsis amblops	bigeye chub	14
Percina maculata	blackside darter	3
Micropterus dolomieui	smallmouth bass	24
Moxostoma valenciennesi	greater redhorse	6
Ambloplites rupestris	rockbass	2
Pimephales notatus	bluntnose minnow	15
Nocomis micropogon	river chub	8
Campostoma anomalum	stoneroller	14
Cyprinus carpio	carp	1
Carpiodes carpio	rivercarp sucker	1
Etheostoma blenniodes	greenside darter	2
Micropterus salmoides	largemouth bass	2
Ammocrypta pellucida	eastern sand darter	1
Notropis stramineus	sand shiner	5
	DELT	16

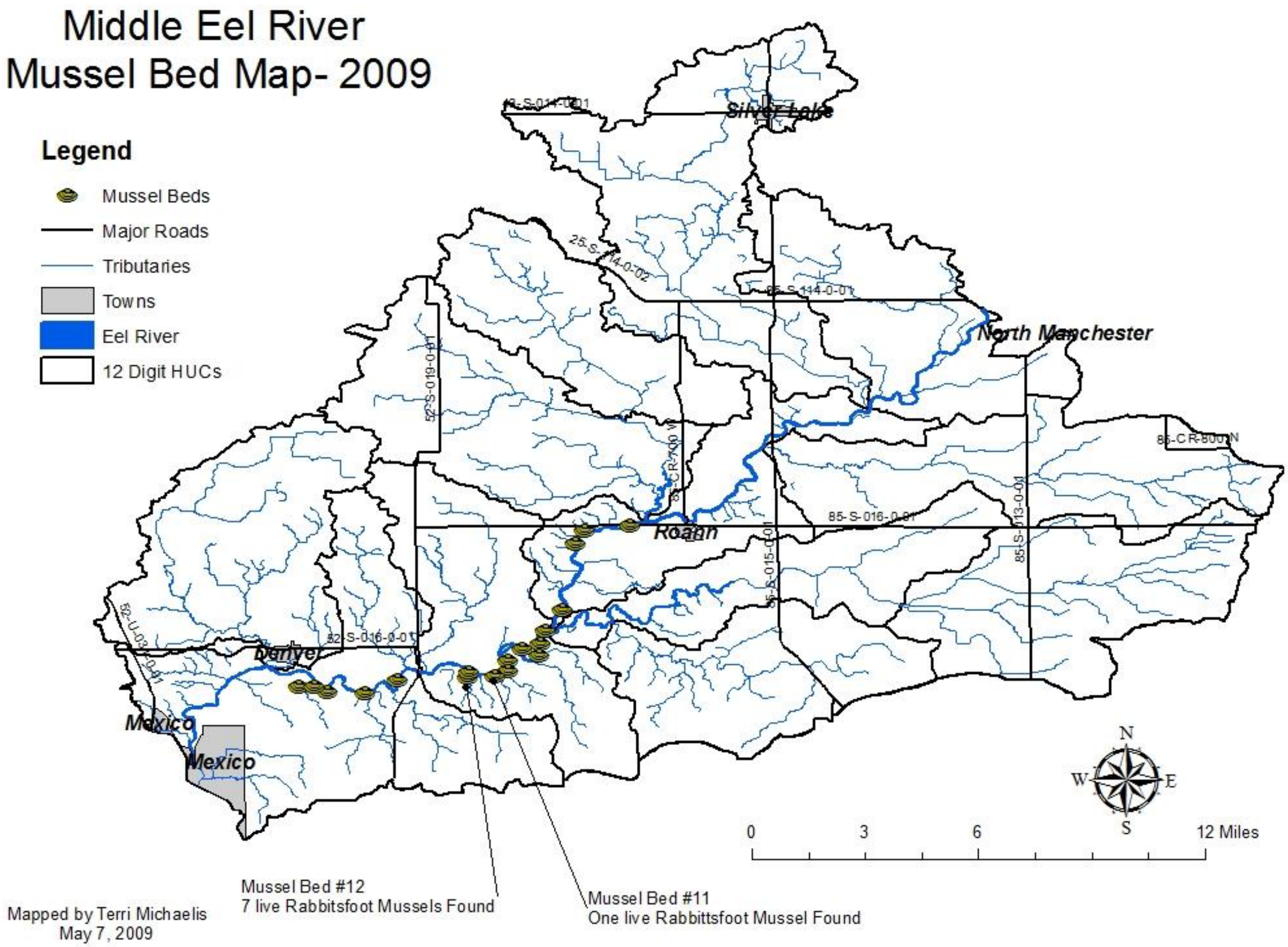
2009 Total number of individuals per species collected for use in obtaining the IBI score by use of a boat shocker and backpack Electrofisher in Mexico, IN on the Eel River (40° 48’ 59.95”N and 86° 06’ 32.55”W)

Scientific Name	Common name	Number of individuals per species collected
Lepomis macrochirus	bluegill	13
Lepomis cyanellus	green sunfish	40
Etheostoma blenniodes	greenside darter	8
Etheostoma spectabile	orangethroat darter	5
Notropis rubellus	rosyface shiner	70
Notropis photogenus	silver shiner	39
Pimephales notatus	bluntnose minnow	90
Cottus Bairdi	sculpin	17
Moxostoma erythrurum	golden redhorse	58
Semotilus atromaculatus	creek chub	74
Campostoma anomalum	stoneroller	46
Ambloplites rupestris	rockbass	7
Lepomis microlophus	redear sunfish	2
Micropterus salmoides	largemouth bass	4
Notropis stramineus	sand shiner	8
Etheostoma nigrum	johnny darter	6
Lepomis gibbosus	pumpkin seed	4
Hybopsis amblops	bigeye chub	16
Fundulus cingulatus	top minnow	4
Erimyzon oblongus	creek chubsucker	1
Percina maculata	blackside darter	3
Catostomus commersoni	white sucker	9
Moxostoma valenciennesi	greater redhorse	6
Hypentelium nigricans	northern hogsucker	40
Luxilus chrysocephalus	striped shiner	51
Notropis spilopterus	spotfin shiner	60
Lepomis megalotis	longear sunfish	8
Micropterus dolomieui	smallmouth bass	24

Nocomis micropogon	river chub	8
Carpiodes carpio	rivercarp sucker	1
Cyprinus carpio	carp	1
Ammocrypta pellucida	eastern sand darter	1
	TOTAL SPECIES = 32	TOTAL INDIVIDUALS = 724
	*DELT	16

APPENDIX F – Mussels Identified live in the Middle Eel River Watershed in 2009. Scientific name followed by common name.

Lampsilis siliquoidea - Fatmucket
Alasmidonta marginata - Elktoe
Amblema plicata - Three Ridge
Cyclonaias tuberculata - Purple Wartyback
Elliptio dilatata – Spike
Fusconaia flava - Wabash Pigtoe
Lampsilis cardium - Plain Pocketbook
Lasmigona costata - Fluted Shell
Corbicula fluminea - Asian Clam
Pleurobema sintoxia - Round Pigtoe
Ptychobranchus fasciolaris - Kidneyshell
Strophitus undulates - Creeper
Quadrula c. cylindrical - Rabbitsfoot



APPENDIX F-2
Mussel Beds Sampled 2009

Appendix G – IDEM Historical Water Monitoring Eel River

HUC to 14	County Name	Latitude Degrees	Latitude Minutes	Latitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	Sample Date	Alkalinity (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	TSS (mg/L)
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	4/3/2007 9:35	214 (fDJ)	< 0.1	3.1	0.1	32
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	5/1/2007 10:35	214	< 0.1	3.1	0.1	16
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	6/26/2007 9:45	264	< 0.1	1.6	0.1	6
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	7/10/2007 9:35	271	< 0.1	0.8	0.09	4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	8/1/2007 12:10	266	< 0.1	1.1	0.14	4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	9/10/2007 10:15	214	< 0.1	2.4	0.2	16
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	10/15/2007 10:45	296	< 0.1	0.7	0.05	< 4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	11/14/2007 9:10	201	< 0.1	5.4	0.28	15
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	12/4/2007 9:45	155	< 0.1	6.2	0.24	35
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	6/18/2008 11:00	214	0.053	4.54	0.236	60
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	7/23/2008 8:20	244	0.071	0.798	< 0.1	9.5
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	8/26/2008 11:30	270	0.023 (UJ)	1.72	< 0.1	9.5
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	7/16/2008 10:05					
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	7/23/2008 11:00					
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	7/30/2008 10:20					
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	8/6/2008 10:00					
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	8/13/2008 9:35					
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	1/14/2008 10:20	137	< 0.1	3.2	0.26	51
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	3/5/2008 9:35	97	0.4	2	0.38	59
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	4/9/2008 12:15	210	< 0.1	2.3	0.11	25
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	5/20/2008 9:40	256	< 0.1	2.8	0.1	6
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	6/17/2008 10:30	196 (Q)	< 0.1	4.4	0.32	124
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	7/22/2008 11:25	266	< 0.1	1	0.08	4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	8/20/2008 10:15	292	< 0.1	1	0.11	4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	9/17/2008 9:30	217	< 0.1	2	0.12	7
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	10/21/2008 11:15	249	< 0.1	0.6	0.06	< 4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	11/25/2008 9:30	293	< 0.1	1.5	0.05	< 4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	12/4/2008 9:25	285 (Q)	< 0.1	1.2	0.03	< 4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	2/24/2009 9:30	221	< 0.1	3.6	0.11	8
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	3/17/2009 10:45	130	< 0.1	3.1	0.21	106
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	4/14/2009 11:00	146	< 0.1	3.2	0.24	86
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	5/19/2009 10:10	186	< 0.1	3.6	0.18	42

5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	6/18/2009 11:40	249	< 0.1	2.9	0.1	13
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	7/23/2009 10:40	263	< 0.1	1.3	0.07	9
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	8/4/2009 11:00	286	< 0.1	1	0.06	< 4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	9/29/2009 9:30	306	< 0.1	1	0.09	< 4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	10/26/2009 10:00	204	< 0.1	5	0.18	21
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	11/16/2009 11:20	296	< 0.1	1.6	0.09	< 4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	12/29/2009 9:05	201	< 0.1	5.3	0.14	15
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	1/26/2010 10:45	128	< 0.1	5.8	0.29	48
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	2/8/2010 10:40	286	< 0.1	2.4	0.06	5

Appendix G – IDEM Historical Water Monitoring Eel River

HUC to 14	County Name	Latitude Degrees	Latitude Minutes	Latitude Seconds	Longitude Degrees	Longitude Minutes	Longitude Seconds	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	6/18/2008	7.66	18.8	84.7	8.03	562	110
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	7/23/2008	7.71	22.46	91.4	8.06	622	8.1
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	8/26/2008	8.41	20.16	95.6	8.12	691	14.2
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	4/3/2007	9.04	12.33		8.17	592	57.8
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	5/1/2007	8.46	16.28		8.32	590	14
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	6/26/2007	3.97	21.3		7.95	713	1.8
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	7/10/2007	6.66	23.6		8.02	705	6.38
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	8/1/2007	7.8	23.25		7.15	730	5.2
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	9/10/2007	6.92	20.26		7.9	622	22.7
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	10/15/2007	9.06	13.95		8.43	765	4.29
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	11/14/2007	7.79	11.46		8.26	675	33.6
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	12/4/2007	9.8	3.69		8.02	570	81
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	1/14/2008	11	3.9		8.17	413	130
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	3/5/2008	12.86	0.65		8.19	335	85.6
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	4/9/2008	7.82	10.88		7.91	591	33.1
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	5/20/2008	8.43	13.38		7.84	636	15.6
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	6/17/2008	8.67	18.66		7.87	549	215
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	7/22/2008	7.73	22.44		8.09	715	6
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	8/20/2008	7.65	19.71		8.22	734	10
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	9/17/2008	7.75	16.52		7.97	625	11.1
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	10/21/2008	10.4	10.52		8.47	732	5.6
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	11/25/2008	13.55	2.21		8.69	771	3.2
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	12/4/2008	12.94	1.52		8.84	761	2.8
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	7/16/2008	9.15	23.56	108	8.11	720	10.9
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	7/23/2008	9.72	22.61	112.7	8.09	718	7.1
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	7/30/2008	7.53	23.94	89.2	8.05	768	15.3

5120104060040	Miami	40	49	32.47031	-86	6	48.13013	8/6/2008	6.63	22.83	77.2	7.93	734	9.5
5120104060040	Miami	40	49	32.47031	-86	6	48.13013	8/13/2008	7.63	20.51	84.9	8	778	22.8
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	2/24/2009	7.87	0.45		7.9	654	13
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	3/17/2009	5.05	8.18		8.02	419	99
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	4/14/2009	10.76	6.69		7.94	463	142
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	5/19/2009	8.61	14.05		7.91	514	48
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	6/18/2009	7.86	18.17		8.33	690	18.3
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	7/23/2009	7.42	19.44		8.15	700	7.92
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	8/4/2009	7.27	21.15		8.21	709	6.62
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	9/29/2009	8.02	13.74		8.37	703	3.8
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	10/26/2009	9.4	10.58		7.94	518	30.4
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	11/16/2009	10.29	9.16		8.35	622	4.1
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	12/29/2009	11.77	1.16		8.73	492	23
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	1/26/2010	12.58	1.57		8.87	386	81
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	2/8/2010	12.82	0.42		8.4	692	8
5120104050030	Wabash	40	56	52.52062	-85	53	26.71885	3/9/2010	11.52	6.13		8.24	601	16.6

APPENDIX H - Tippecanoe Audubon Society Breeding Bird Survey 2010.

Summary of Middle Eel River Watershed Breeding Bird Survey for June 2010					
Subwatershed:	Paw-Paw Crk	Paw-Paw Crk	Beargrass	Squirrel/	Lower Squirrel-
	Oren Ditch	Sharp Ditch	Creek	Berger Ditch	Roann
Date:	6/26/2010	6/26/2010	6/12/2010	6/5/2010	6/19/2010
Total species observed:	60	31	66	62	53
Canada Goose	X				
Mallard	X		X	X	
Blue-winged Teal				X	
Ring-necked Pheasant			X	X	
Northern Bobwhite	X		X	X	
Sora			X		
Great Blue Heron	X	X	X	X	
Green Heron				X	
Turkey Vulture	X	X	X	X	X
Sharp-shinned Hawk			X		X
Cooper's Hawk			X		
Red-tailed Hawk	X		X	X	X
American Kestrel	X	X		X	X
American Coot			X		
Killdeer	X	X	X	X	X
Rock Pigeon	X		X	X	
Mourning Dove	X	X	X	X	X
Yellow-billed Cuckoo	X			X	X
Chimney Swift			X	X	X
Ruby-throated Hummingbird	X			X	X
Belted Kingfisher	X			X	
Red-headed Woodpecker			X	X	X
Red-bellied Woodpecker	X		X	X	X
Downy Woodpecker		X	X	X	
Hairy Woodpecker	X				
Northern Flicker	X	X	X	X	X
Eastern Wood-Pewee	X	X	X	X	X
Acadian Flycatcher	X		X	X	X
Alder Flycatcher			X	X	
Willow Flycatcher			X	X	
Eastern Phoebe	X		X	X	X
Great Crested Flycatcher	X		X	X	
Eastern Kingbird	X		X	X	X
Yellow-throated Vireo	X				X
Warbling Vireo	X		X	X	

Red-eyed Vireo	X	X	X		
White-Eyed Vireo	X				X
Blue Jay	X		X		X
American Crow	X		X	X	X
Horned Lark			X		
Purple Martin		X	X		X
Tree Swallow	X	X	X	X	X
N. Rough-winged Swallow				X	X
Barn Swallow	X	X	X	X	X
Black-capped Chickadee			X	X	X
Tufted Titmouse	X	X	X	X	X
White-breasted Nuthatch	X		X	X	X
Carolina Wren	X		X	X	X
House Wren	X	X	X	X	X
Blue-gray Gnatcatcher	X		X		
Eastern Bluebird			X	X	X
Wood Thrush	X		X	X	X
American Robin	X	X	X	X	X
Gray Catbird	X	X	X	X	X
Northern Mockingbird	X			X	X
Brown Thrasher			X		X
European Starling	X	X	X	X	
Cedar Waxwing			X		
Northern Parula			X		X
Yellow Warbler	X		X	X	X
Yellow-throated Warbler	X				
Prothonotary Warbler	X				X
Common Yellowthroat		X	X	X	X
Yellow-breasted Chat	X				
Scarlet Tanager			X	X	
Eastern Towhee	X	X			
Chipping Sparrow	X	X	X	X	X
Field Sparrow	X	X	X	X	X
Vesper Sparrow			X		
Savannah Sparrow	X		X	X	
Grasshopper Sparrow				X	
Song Sparrow	X	X	X	X	X
Northern Cardinal	X	X	X	X	X
Rose-breasted Grosbeak	X				
Indigo Bunting	X	X	X	X	X
Dickcissel	X	X	X	X	X
Bobolink				X	
Red-winged Blackbird	X	X	X	X	X
Eastern Meadowlark	X	X	X	X	X
Common Grackle	X	X	X	X	X
Brown-headed Cowbird	X	X	X	X	X
Baltimore Oriole	X		X	X	X

House Finch	X		X		X
American Goldfinch	X	X	X	X	X
House Sparrow	X	X	X	X	X